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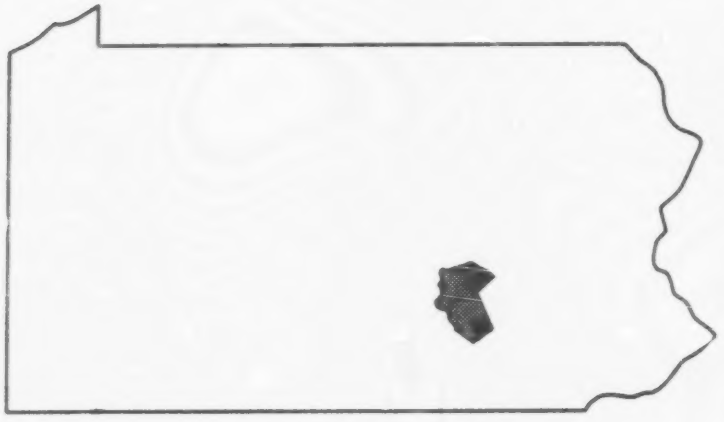
FLOOD INSURANCE STUDY

ORIGINAL

TOWNSHIP OF CONEWAGO, PENNSYLVANIA
DAUPHIN COUNTY



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PUBLISHED SEPARATELY:

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FLOOD INSURANCE STUDY
TOWNSHIP OF CONEWAGO, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Conewago, Dauphin County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Conewago to the regular program of flood insurance by the Federal Emergency Management Agency (FEMA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

This Flood Insurance Study was prepared by compiling pertinent information for the flood hazard areas in the Township of Conewago from existing technical and/or scientific data originally prepared by others for purposes other than the preparation of this Flood Insurance Study. This existing data was reviewed by FEMA prior to its use in the development of this Flood Insurance Study to ensure compliance with National Flood Insurance Program (NFIP) accuracy requirements.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by Roy F. Weston, Inc., during the preparation of the Flood Insurance Study for the Township of Mount Joy. The Mount Joy study was completed in June 1979.

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1.3 Coordination

On June 10, 1985, the results of this study were reviewed at a final Consultation and Coordination Officer's (CCO) meeting attended by representatives of FEMA and the Township of Conewago.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Conewago, Dauphin County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

Conewago Creek East was studied by detailed methods from the downstream corporate limits to State Route 283. The areas studied by detailed methods were selected based upon the extent and validity of available existing hydrologic and hydraulic data.

Hoffer Creek, several unnamed tributaries, and the remaining portion of Conewago Creek East within the corporate limits were studied by approximate methods. Approximate methods of analysis were used to study all remaining areas having a potential flood hazard that did not have available scientific or technical data.

2.2 Community Description

The Township of Conewago is located in the southeastern portion of Dauphin County in southeastern Pennsylvania. It is bordered by the Township of South Londonderry to the east, the Township of Mount Joy to the south, the Township of Londonderry to the southwest, and the Township of Derry to the north.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at

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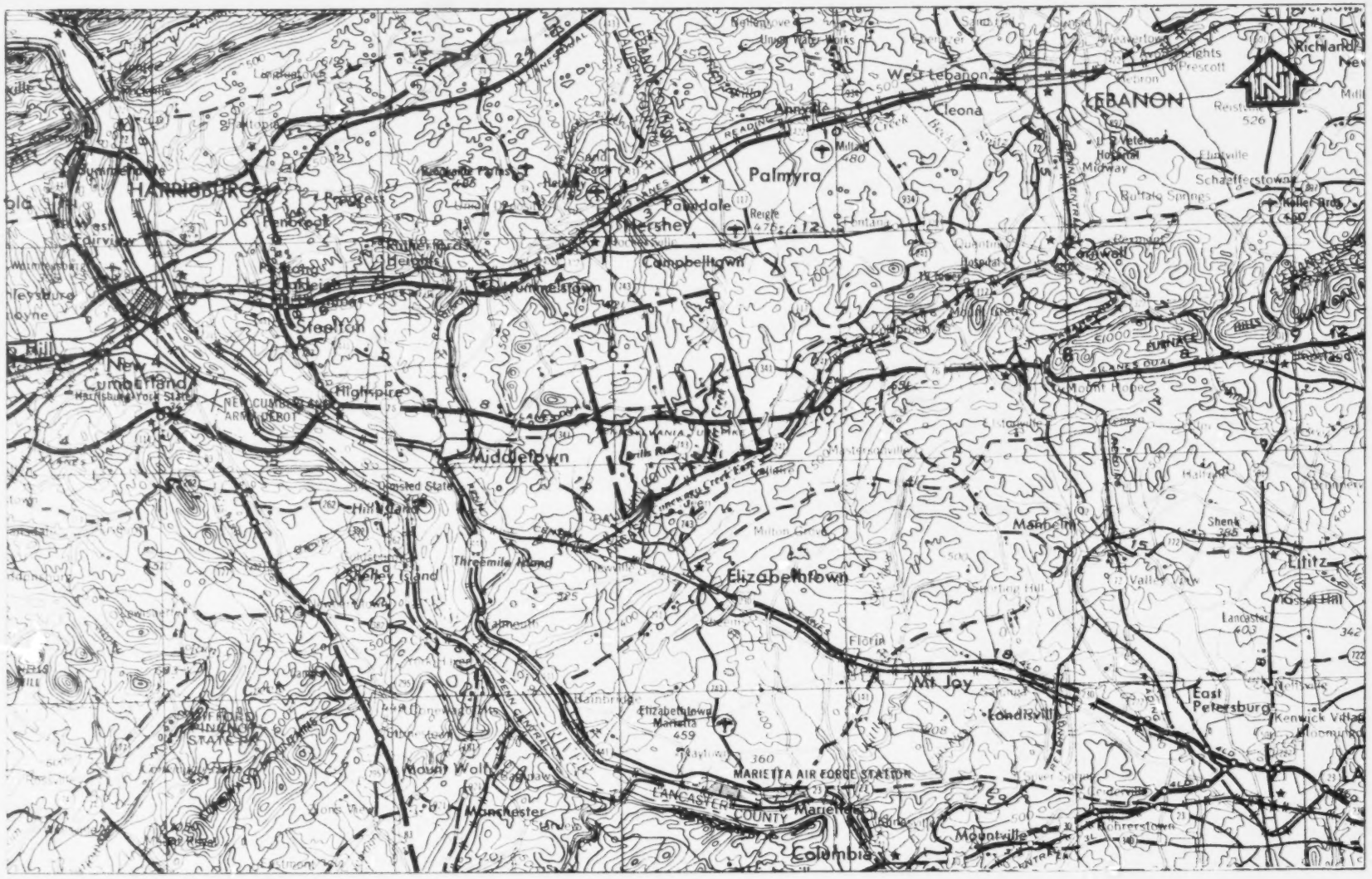

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF CONEWAGO, PA

(DAUPHIN CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

3

short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding source studied in detail affecting the community.

Discharges for Conewago Creek East were obtained from the Flood Insurance Study for the Township of Mount Joy (Reference 1). In the Mount Joy study, the log-Pearson Type III method for determining discharge relationships was used (Reference 2). For gaged sites, the flood-frequency data can be obtained directly from statistical analyses of flood peak discharge data. For ungaged sites, it was necessary to regionalize the flood-frequency data for two or more sites.

The log-Pearson Type III method requires the mean (M), the standard deviation (S), and the skew coefficient. For Conewago Creek East, which is an ungaged stream, this information was obtained from the regional flood-frequency procedure developed by the U. S. Army Corps of Engineers (COE) (Reference 3). This procedure was based on a log-Pearson Type III analysis of a large number of station records in the Susquehanna River basin through 1972. The log-Pearson analysis was made using the following equations:

$$M = C_m + 0.75 \log (A)$$
$$S = C_s - 0.05 \log (A)$$

where A is the drainage area in square miles and C_m and C_s are coefficients obtained from maps. The skew coefficient is also obtained from a map. The Susquehanna River Basin Commission made some modifications to the C_m map and also the skew coefficient map for use in this study.

A summary of drainage area-peak discharge relationships for Conewago Creek East is shown in Table 1, "Summary of Discharges."

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TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CONEWAGO CREEK EAST					
At State Route 230	36.9	4,700	9,800	12,900	24,700
Upstream of the confluence of Brilles Run	31.6	3,960	8,260	10,870	20,810

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross-section data for Conewago Creek East were obtained from topographic maps compiled from aerial photographs (Reference 4). Below-water sections were obtained by field measurements. All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 5). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for Conewago Creek East were obtained from the Flood Insurance Study for the Township of Londonderry (Reference 6).

Roughness coefficients (Manning's "n") used in the hydraulic computations were assigned on the basis of field inspection and photographs of the flood plain. The channel "n" values for Conewago Creek East ranged from 0.035 to 0.040, and the overbank "n" values ranged from 0.050 to 0.055.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

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4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (Reference 4).

For the streams studied by approximate methods, the boundary of the 100-year flood was delineated using the Flood Hazard Boundary Map for Conewago (Reference 7).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this study is presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

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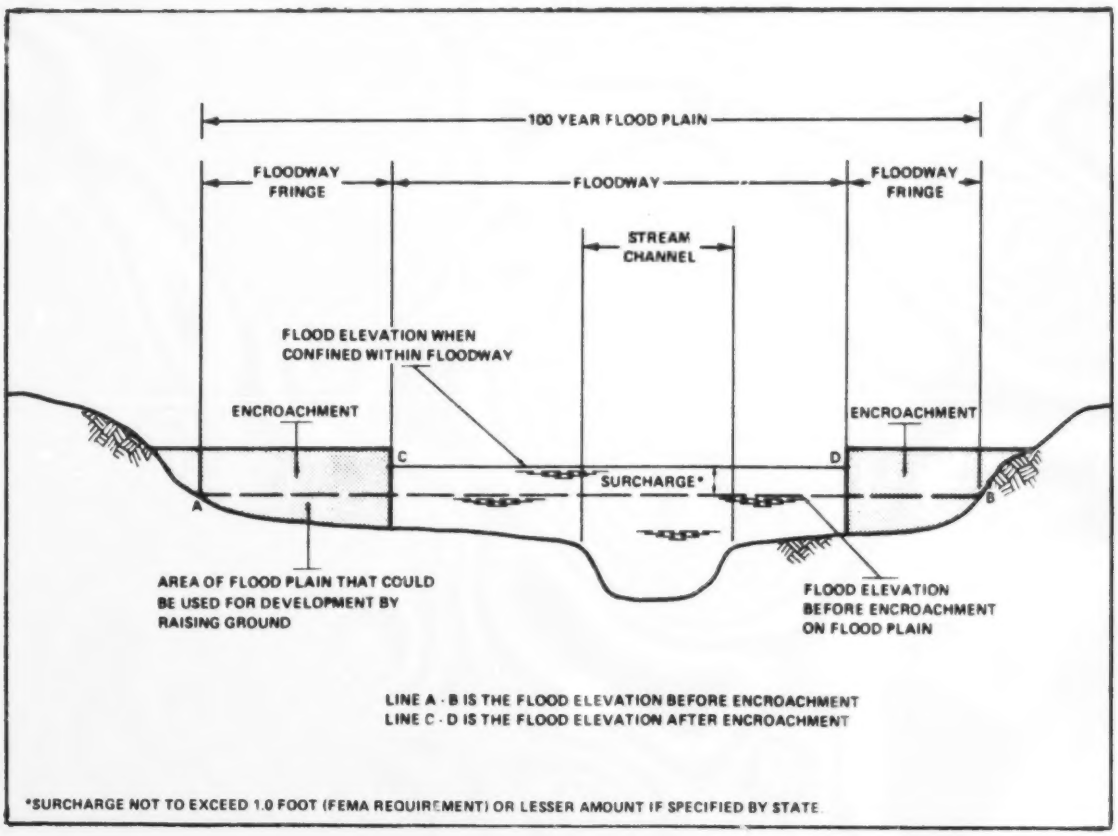
The floodway presented in this study was computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for the stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown. Portions of the floodway widths for Conewago Creek East extend beyond the corporate limits.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

Floodway Schematic - Figure 2

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Conewago Creek East								
A	43,665	810	5,961	2.2	387.7	387.7	388.7	1.0
B	46,445	785	4,085	2.7	388.9	388.9	389.8	0.9
C	48,625	288	1,509	7.2	394.6	394.6	394.6	0.0
D	50,425	356	1,404	7.7	410.8	410.8	411.1	0.3
E	53,765	857	5,180	2.1	416.6	416.6	417.4	0.8

[1]Feet above confluence with Susquehanna River

[2]This width extends beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF CONEWAGO, PA
(DAUPHIN CO.)

FLOODWAY DATA

CONEWAGO CREEK EAST

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for the flooding source studied in detail in the Township of Conewago.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding source of the Township of Conewago are shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Conewego Creek East							
Reach 1	05	-4.5	-1.5	+4.6	045	A9	Varies
Reach 2	05	-3.1	-0.9	+2.5	030	A6	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF CONEWAGO, PA
(DAUPHIN CO.)

FLOOD INSURANCE ZONE DATA

CONEWAGO CREEK EAST

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.

Zones A6 and A9: Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.

Zone B: Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding source studied in detail in the community are shown in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Conewago is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

This Flood Insurance Study was prepared by compiling existing hydrologic and hydraulic technical and scientific data prepared by other organizations originally for purposes other than the preparation of this Flood Insurance

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Study. The data was identified as the best available at the time of compilation of this Flood Insurance Study and should depict the general conditions of the flooding sources with relative accuracy. FEMA performed a cursory review and accepted the data as valid for purposes of this Flood Insurance Study and the NFIP. However, if better information is known to exist or has been developed since the date of this report, the information should be immediately forwarded to the Natural and Technological Hazards Division, Federal Emergency Management Agency (Regional Director, Region III Office, Liberty Square Building (Second Floor), 105 South Seventh Street, Pennsylvania 19106) for consideration for revision of this study.

Flood Insurance Studies for the Townships of Mount Joy, Londonderry, and Derry have been completed (References 1, 6, and 8). The results of this study are in exact agreement with the results of those studies.

A Flood Hazard Boundary Map has been published for the Township of Conewago (Reference 7). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region III Office, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

8.0 BIBLIOGRAPHY AND REFERENCES

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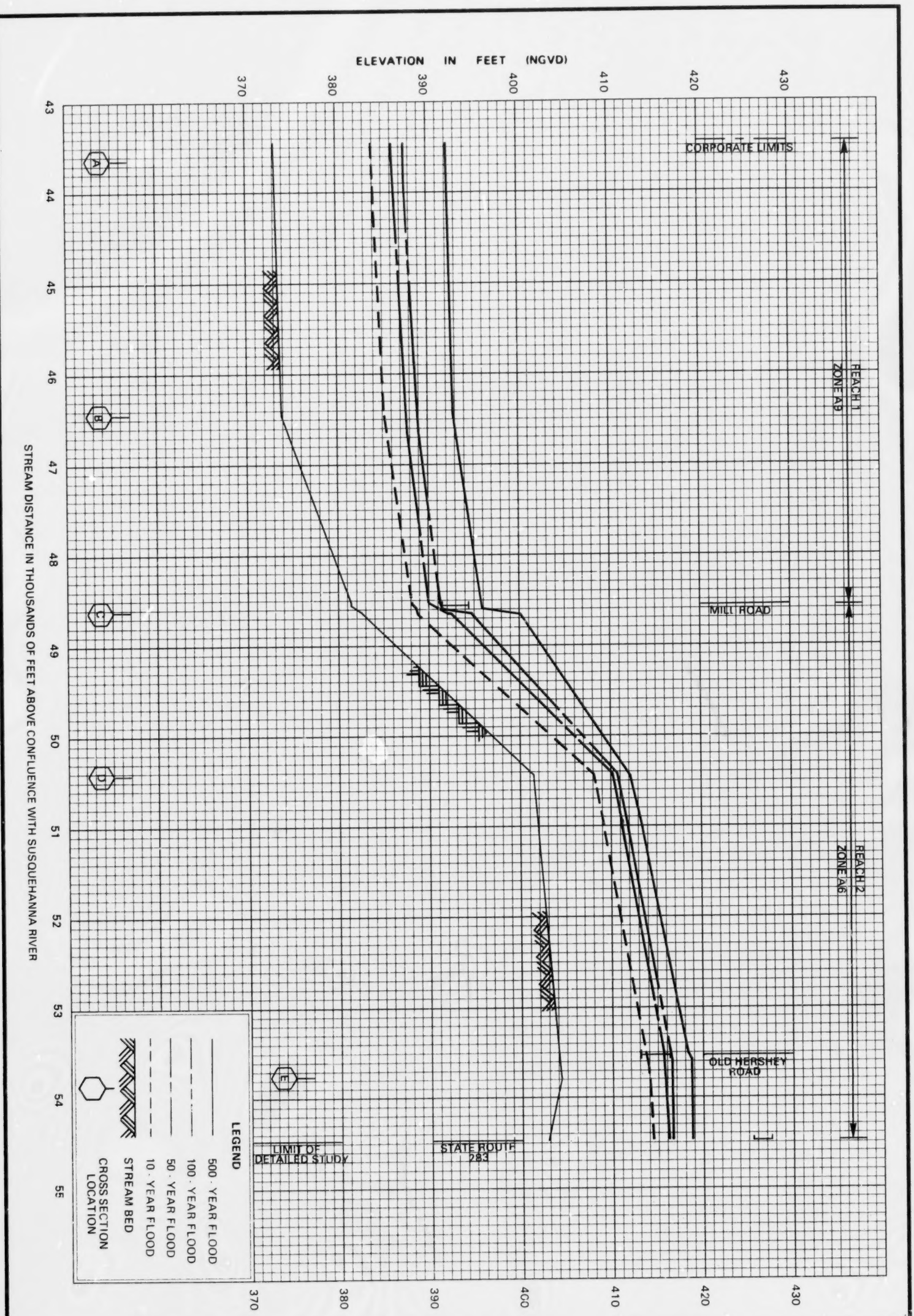

01P	FEDERAL EMERGENCY MANAGEMENT AGENCY **TOWNSHIP OF CONEWAGO, PA** (DAUPHIN CO.)	**FLOOD PROFILES** **CONEWAGO CREEK EAST**